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(71) Applicant 000005108
Hitachi Works Co. Ltd.
Surugadai 4-chome 6-banchi
Kanda, Chitoda-ku, Tokyo-to

(72) Inventor Takuo Kawaguchi
Taga Head Office, Electric Appliances Project Division, Hitachi Works Co. Ltd., Higashi Taga-cho 1-chome 1-ban 1-go, Hitachi-shi, Ibaraki-ken

(72) Inventor Yuka Hirota
Taga Head Office, Electric Appliances Project Division, Hitachi Works Co. Ltd., Higashi Taga-cho 1-chome 1-ban 1-go, Hitachi-shi, Ibaraki-ken

(74) Attorney Patent attorney Akio Takahashi
(and 1 other person)

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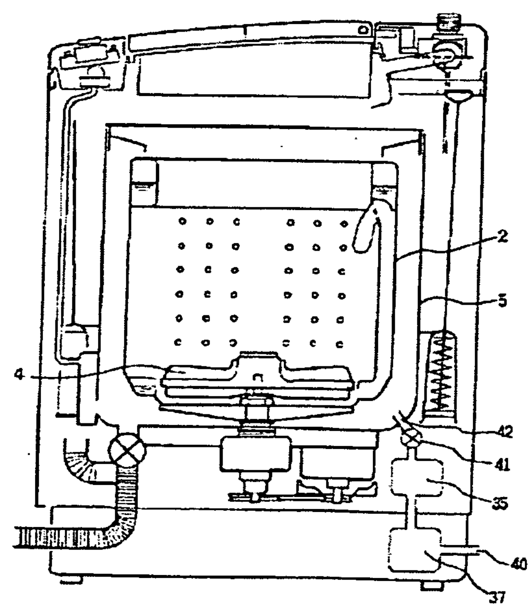
1) This doc. focuses on the treatment of waste water and ozone is introduced into said waste water
2) The ozone is dissolved in the waste water
3) It is emphasised that ozone should not be introduced into the aqueous solution containing the detergent as it will break down the detergent
4) In para 83 it is stated that not all ozone dissolves in H_2O, and is released in atmosphere. It appears (?) that such undissolved ozone will be go into the washing cavity (to create an atmosphere of O_3). If so claim 1 will be anticipated.
5) Para 91 also refers to getting ozone in final rinsing step (not only treatment of waste water)
6) Can look at introducing subj. matter of claim 2 and also rate at which O_3 is introduced (p3 line 25)
7) What about introducing O_3 early, say at least during washing cycle?
8) What about low temp washing - see also 4.1 of WO

(54) [Name of the invention] Household washing appliances

(57) [Summary]

[Problem to be solved] The aim of this invention was to develop household washing appliances which drain the dirty water from the appliances after purifying the dirt constituent which is produced in the washing process with the use of a detergent where this drainage water has a particularly high organic matter concentration for drainage water which is produced through the use of household washing appliances such as washing machines and dish washers and thus to reduce the COD and BOD values in the drainage water.

Figure 2



[Measures adopted to solve the problem] This invention describes household washing appliances which use water as a washing solvent and employ a detergent and which have an ozone generating mechanism using the oxygen in the air and in the water as a raw material. Further, it has the characteristic that the appliances have a control mechanism in which a process to dissolve the ozone generated from the ozone generating mechanism described above into the washing solution is added after completing the washing process during which the detergent is used.

Does not teach that ozonated water is contacted with wash. Does not teach that ozone is introduced into washing cavity to provide a gaseous atm.

[Extent of the patent claims]

[Claim item 1] Household washing appliances which have the characteristics that they use water as a washing solvent, use a detergent and, have an ozone generating mechanism using oxygen in the air and in water as a raw material. Further, the appliances have the characteristics that they incorporate a control mechanism in which a process for dissolving the ozone which is generated from the ozone generating mechanism described above into the washing solution is added after completing the washing process during which the detergent is used.

[Claim item 2] The household washing appliances described in the patent claim item 1 which have a structure where the appliances have a washing solution collection section which is separate from the washing tank used for washing laundry in order to temporarily store the washing solution which is used for washing and that ozone is dissolved into the washing solution which is collected in the washing solution collection section.

[Claim item 3] The household washing appliances described in the patent claim item 2 where the volume of the solution in the washing solution collection section is less than the volume of the washing solution used in the washing process during which the laundry is washed with the aid of a detergent.

[Claim item 4] The household washing appliances described in the patent claim item 1 which have a mechanism to control the amount of ozone generated in accordance with the amount of water used for washing.

[Claim item 5] The household washing appliances described in the patent claim item 1 which have a structure where ozone is dispersed and dissolved into the washing solution using the viscosity of the moving washing solution which is produced as a result of the function of the agitation of the washing solution.

[Detailed description of the invention]

[0001]

[Technical area of application to which this invention belongs] This invention concerns household washing appliances such as washing machines and dish washers and further, in more detail it describes a drainage water treatment device where the water containing a large amount of organic matter such as detergent which is produced and discharged from a washing machine or a dish washer is oxidised and decomposed using ozone which is then drained into the sewerage system.

[0002]

[Former technology] The structure of a general washing machine will now be explained with the aid of the basic structural drawing of a fully automatic washing machine which is described in Figure 1.

[0003] The item 1 which appears in Figure 1 is the outer frame while 2 is the tank used for washing as well as for spin drying. A fluid balancer 3, is installed on top of the water tank used for both washing and spin drying. An agitation impeller 4, which rotates freely is arranged in the lower section of the tank which is used for both washing and spin drying.

[0004] Item 5 is an outer tank which covers the washing and spin drying tank 2. A drive section is installed in the lower section of the outer tank 5, through a central base 6, which is made from a steel plate and, at the same time, it is suspended and supported by a vibration preventing device 7, from the four corners of the top of the outer frame 1.

[0005] The drive section is composed of a motor 8, a clutch 9, a V-belt 10, a motorised pulley 11, and a P pulley 12. The rotation of the motor 8, is transmitted to the clutch 9, via the motorised pulley 11, the V-belt 10, and the P pulley 12. The clutch 9, transmits the rotational force of the motor 8, to the washing and spin drying tank 2, via a reduction gear which is installed inside the clutch to perform spin drying.

[0006] Item 13 which appears in Figure 1 is a water supply electromagnetic valve and one end is connected to the water tap and the other end to the water inlet 14.

[0007] Item 15 which appears in Figure 1 is an upper surface cover which has a panel box section, inside of which there is a control unit 16, a water level sensor to control the water level 17, an electrical supply switch 18, an input switch section 19, and a washing progress display section 20. Item 21 refers to the panel box sections which are located in two places, one in front and the other at the rear. 22 is a front panel while 23 is a back panel. The lid 25, which can freely open and close is located on top of the opening 24, which is placed in between the front and back panels 22 and 23.

[0008] A projecting rib 46, is located on the bottom surface of the agitation impeller, 4. The rib 46, performs the role of reinforcing the rigidity of the agitation impeller 4, as well as the function of producing the water pressure in the washing water. The water pressure which is generated by the projecting rib 46, is released in the vicinity of the surface of the washing solution through the filter case 47. During this release the washing solution passes through the filter 48, which catches and collects lint and waste which come from the laundry.

[0009] Item 27 which appears in Figure 1 is a draining device which is composed of a drain stop valve 28, an interior water drainage hose 29, and an external water drainage hose 30. One end of the drain stop valve 28, is fitted to the drainage water opening 5a, which is located in the lower section of the outer tank 5 while the other end is connected to the interior water drainage hose, 29.

[0010] A synthetic resin base 34, with leg sections is fitted on the lower surface of the frame unit 1. Legs are positioned at the four corners of the base 34, with one leg at each corner. The right front leg 32, can adjust the height while the remaining 3 legs 33, have fixed heights.

[0011] Next, a series of the most general laundry processes for a fully automatic washing machine of this type will be explained.

[0012] During laundry (washing process), the laundry (material to be washed) and the detergent are put inside the washing spin drying tank 2, and when the machine starts running water is supplied from the electromagnetic water supply valve 13. The amount of water supplied is detected by the water level sensor 17, and when the water level reaches the prescribed amount the electricity to the electromagnetic water supply valve 13, is turned off. The agitation impeller 4, is rotated by driving the motor 8, to agitate the laundry (material being washed).

[0013] When the laundry (washing process) is completed, the drainage water valve 28, is opened and the water is discharged to the drainage exit 31 via the interior water drainage hose 29, and the external water drainage hose 30.

[0014] During spin drying, while the drainage stop valve 28, remains open the driving force of the motor 8, is transferred to the washing and the spin drying tank 2, by changing the clutch 9. The laundry is spin dried by the centrifugal force from the rotation of the washing and the spin drying tank 2. Afterwards the rinsing process begins.

[0015] Various types of methods are used in the rinsing process including shower rinsing and stored water rinsing. In each of the methods the purpose of the rinse is to extract the remaining small amount of detergent and dirt by changing the water and agitating the laundry (material to be washed).

[0016] Further in the washing and rinsing processes, water in the lower section is raised by the lifting force which is generated by the projecting rib 46, through the filter case 47, and the lint and waste are collected on the filter 48, during the time that the water is jetting out in the vicinity of the surface of the water.

[0017] With the recent increasing awareness towards global environmental problems, a new mechanism with the purpose of not only saving energy and water but also of improving the ability to recycle during the disposal of the product has been considered and put to practical use in new products. In addition, various types of efforts in terms of laundry detergents have been made which have been directed towards reducing the resource wastage for total laundry operations such as decreasing the amount of detergent which is used by introducing concentrated constituent mixtures.

[0018]

[Problems which this invention attempts to solve] The drainage water from the laundry is discharged into the sewerage system and centralised for treatment in a region which is fully equipped with sewerage facilities, however, outside those regions where there are no sewerage facilities the drainage water from the laundry is discharged into rivers and pollutes lakes, swamps and seawater. When the amount of polluted water exceeds the limit for the natural purification reaction of the rivers, this has a huge negative influence on the natural environment such that not only does polluted water accumulate and the toxicity of the chemicals results in direct environmental problems but this also causes abnormal breeding of algae and aqueous organisms as the water quality is nourished excessively. Drainage water from laundries contains detergents and furthermore organic matter such as dirt which is removed from the clothing which leads to those problems of environmental responsibility that have been discussed above. The constituents of the dirt are inorganic matter such as soil and dust and organic matter such as sebum and sweat and the organic matter in particular enriches the nutritional water quality.

[0019] In addition in the same way as the dirt, inorganic and organic matter are mixed in the constituents of the detergent. The constituent components are predominantly surfactants and, in addition to these, inorganic salts which are called aids or additives such as enzymes and fluorescent materials are mixed together. The ability of the surfactants to decompose or the enriched nutritional quality of the environment as a result of the nitrogen, phosphorus system aids have become problematic in the past and, although some improvements have been made they cannot be regarded as drastic measures to improve the situation as long as washing solutions containing detergents are currently discharged in their present form.

[0020] Formerly known treatment technologies used for drainage water from washing machines include treatment technologies which employ the decomposition reaction of microorganisms as described in the Japanese Patent Hei 5-315095 (JP05315095). However, there is still room for improvement with this technology as a long period of time is required to treat the drainage water. In other words according to this technology, microorganisms within the washing solution naturally breed in porous materials and decompose the drainage water, however, it takes a long period of time to form a stable microorganism layer and even once the layer has formed it requires at least a few hours for treatment. Consequently the drainage water has to be stored in the machine for a long period of time and it does not function well during the winter season when the water temperature is low. Furthermore, conversely when hot water from a hot water supply system or a disinfectant bleaching agent such as a hypochlorous acid system or a cleaning agent for cleaning the washing machine are employed, the microorganisms that have grown die out and hence the effect vanishes. In addition, a pungent smell from the substances which are produced during the metabolic processes of the microorganisms drifts backward towards the washing tank side and this odour may become problematic. It can be concluded from these drawbacks that the treatment of drainage water by microorganisms is suitable in the case when a large amount of water is treated in a purification tank or in centralised treatment facilities where control is possible, however, it is not suitable for application as an incidental mechanism for a washing machine.

[0021] Incidentally, another well known technology which is detailed in the Japanese Patent Hei 6-126090 (JP06126090) describes how a portion of the drainage water is filled into another container which is rotated at a high speed after the water has foamed using a foam generation mechanism and a very small quantity of foam is collected from the side for reuse. In other words this technology combines a foam generation mechanism and a high speed rotation mechanism. A facility which applies this technology cannot be established inside the washing machine as there are space constraints and further, a large scale driving force generating mechanism is required. In addition, since the concentration of the detergent in the collected solution cannot be controlled, even if the collected solution is reused during the next washing operation, the amount of detergent that can be saved is uncertain.

[0022] Further, the former technology in which ozone is mixed into the washing solution in a washing machine is described in, for example, the Japanese Patents Hei 5-161773 (JP05161773), Hei 5-253380 (JP05253380), Hei 6-319891 (JP06319891) and Hei 7-88277 (JP0788277). These patents describe how ozone is mixed into the washing solution and is used together with a detergent. These patents explain that the effect of the ozone decomposition improves the cleaning effect while the disinfectant properties promote cleanliness.

[0023] In other words, ozone through the power of oxidation, decomposes the constituents of various types of detergents such as surfactants, bleaching ingredients, enzymes, fluorescent ingredients, metal neutralisers and perfumes as well as contaminants such as proteins and various types of fatty acids or fatty acid esters which are present in sebum or sweat constituents that break away from clothing and are decomposed into a low molecular state so that the amount of oxygen demand such as the BOD (biological oxygen demand) or the COD (chemical oxygen demand) within the drainage water from the washing process decreases.

[0024] However, it was found from the results of an investigation by the inventors of this patent that when ozone is mixed into an aqueous solution containing various types of detergents used for washing clothing which are available on the market, the detergent undergoes oxidation by the ozone particularly with the constituents of the surfactants and enzymes playing a lead role with the result that the cleaning efficiency is reduced.

[0025] The aim of this invention was to develop household washing appliances which drain the dirty water from the appliances after purifying the dirt constituents which are produced in the washing process through the use of detergents where this drainage water has a particularly high organic matter concentration that is produced through the use of household washing appliances such as washing machines and dish washers and thus to reduce the COD and BOD values in the drainage water.

[0026]

[Measures which were adopted in order to solve the problems] The problems described above can be solved by developing household washing appliances which use water as a washing solvent and employ a detergent and which have an ozone generating mechanism using the oxygen in the air and in the water as a raw material.

Further, the appliances have a control mechanism in which a process to dissolve the ozone generated from the ozone generating mechanism described above into the washing solution is added after completing the washing process during which the detergent is used.

[0027] The following technology can be applied to reduce the BOD and the COD values of the aqueous solution containing organic matter such as in sewerage and river water.

[0028] In other words, filtration which uses a filter or an adsorption process can be applied as a physical treatment method. In addition, an oxidation or a reduction method can be applied as a treatment which makes use of a chemical reaction. Furthermore, a method which employs the aerobic features of activated sludge or which uses anaerobic bacteria can be applied as a treatment method using microorganisms. A catalyst or a precipitation coagulation agent can be used together in addition to the methods described above in order to increase the efficiency.

[0029] As mentioned earlier in the methods described above, a microorganism method would be unsuitable for household washing appliances such as washing machines and dish washers.

[0030] In addition, since a physical method requires a process of washing and of transforming the organic matter which are filtered and adsorbed, not only is complex maintenance required but further disposal of these filter materials becomes problematic and consequently it is difficult to consider a physical method as a solution for environmental problems.

[0031] As for a method which uses a chemical reaction, a method in which an oxidising or a reducing agent is added is unsuitable since problems with the supply of the chemicals as well as with the toxicity of the residual chemicals arise.

[0032] The principle that organic matter can be decomposed through the use of the strong oxidation power of ozone is the basis of this invention.

[0033] The supply of oxygen which is a raw material used for the generation of ozone is not problematic. On the other hand, it is not only safe as the excess ozone which is generated returns to oxygen again over time but it also has the effect of increasing the concentration of the dissolved oxygen in the water.

[0034] In order to maximise the effectiveness of the detergent, physical force should be applied to the clothing through agitation of the washing solution for a sufficient duration so that the dirt dissolves and is removed. Then this washing solution must be treated using ozone to be most effective. This is because if ozone is mixed in during the time that washing is being performed various types of organic detergent constituents such as surfactants or enzymes decompose which results in a reduction in the effectiveness of the washing process.

[0035] In addition as mentioned earlier, a former technology in which ozone is mixed into the washing solution in the washing machine is described in, for example, the Japanese Patent Hei 5-161773 (JP05161773). This patent describes how ozone is mixed into the washing solution and is used together with the detergent. However, it was found from the results of an investigation by the inventors of this patent that when ozone is mixed into an aqueous solution of various types of detergents used for washing clothing which are available on the market, the detergent undergoes oxidation by the ozone with the constituents of the surfactants and the enzymes in particular playing a leading role and, as a result, the cleaning efficiency is reduced.

[0036] In contrast to the result described above, since this invention has the characteristic that ozone reacts with the washing solution after completing the washing process using a detergent, the washing effectiveness cannot deteriorate.

[0037] Incidentally the effectiveness can be further increased if separate tanks are used for the washing and the water tanks where the ozone is mixed. In other words, since the time spent on the total washing process increases when the ozone is mixed into the washing tank, the washing solution is stored in another tank and the treatment using the ozone is done in this other tank so that sufficient time can be spent on the treatment in order to decrease the COD value sufficiently. In addition, as the concentration of the ozone increases the treatment efficiency improves, however, on the other hand, although it has not been mentioned in the series of already known examples which were described earlier, since the ozone decomposes and breaks apart a double bond having an absorbance characteristic in the visible range which is present in colouring materials which changes into the ultraviolet range, in the case when the washing appliance is a washing machine, this causes discolouration / fading of the laundry (material being washed) and leads to damage of the clothing fibres. Thus, in order to increase the treatment efficiency using a high ozone concentration, it is suitable to perform the treatment using the ozone in another tank. In the case when a separate tank is used for the treatment, it is not necessary to use all of the washing solution which was used for washing the laundry. For example, in the case when the washing appliance is a washing machine, the capacity needed for the laundry increases year after year, however since the space needed to install the machine is limited, the excess spare capacity inside the washing machine is extremely small. Consequently, it is difficult to find the space to store all of the washing solution that is used which is normally in a range of between 40 and 80kg. In the case when a portion of the washing solution that is used is treated, the same effect can be achieved where the COD value of the total washing solution used decreases slightly in terms of the total amount.

[0038]
[Practical implementation of the invention] The case where this invention is applied to a fully automatic washing machine will be used as an example and the details will be explained below with the aid of figures.

[0039] Figure 2 shows the structure of a washing machine in the case when the ozone is jetted out into the washing solution in the washing and spin drying tank 2, using an air pump 35, as the first implementation example of this invention.

[0040] In this implementation example the outlet spout 42, is linked in the vicinity of the lower section of the outer tank 5, and the air containing ozone jets out from this outlet into the water.

[0041] The air supply valve 41, is closed during the time when the ozone is not supplied.

[0042] The ozone generator 37, is activated to jet the ozone into the washing solution, while at the same time the air pump 35 is activated and the air supply valve 41, is opened. Through the series of actions described above, a portion of the oxygen in the air which is drawn in from the intake 40, is excited inside the ozone generator 37, using electric energy which is then converted into ozone. This air which contains the ozone jets out in the form of a foam into the washing solution which is stored in the outer tank 5, as a result of the pressure which is produced by the air pump 35. The ozone in the foam dissolves into the water and through the oxidising power the organic matter in the water is oxidised and decomposed and is converted into low molecular compounds which results in a decrease in the COD and BOD values in the washing water.

[0043] It is preferable to conduct the ozone treatment on the washing solution which is generated during the washing process when a detergent is used. In other words, this is because the amount of organic matter in the drainage water during the washing process is overwhelmingly larger in comparison with the amount of organic matter in the drainage water which is discharged during the rinsing process. In the washing process, a large amount of detergent constituents as well as dirt components which are extracted from the laundry by the detergent are dispersed.

[0044] Table 1 gives a description of the standard washing process which was formerly used and the COD values of the drainage water which is discharged in each process.

[0046] As is apparent from Table 1, the COD value of the drainage water after the washing process is much larger than that of the drainage water during each rinsing process which is conducted after the washing process.

[0047] Table 2 shows the washing process in which the ozone jetting process is applied in the implementation example.

[0049] Jetting of the ozone is conducted immediately after the completion of the washing process. As described above, if the ozone is jetted out at the same time as the agitation operation is being conducted during washing, then not only will the dirt constituents but also the detergent constituents themselves oxidise and decompose and, as a result, the washing performance of the detergent which can normally be expected will deteriorate. Consequently, the ozone treatment is conducted on the entire washing solution in the state where the dirt has been extracted sufficiently from the laundry. During the time when the ozone is jetted, if the agitation impeller 4, is rotated and the whole washing solution is agitated then the ozone foam will be evenly dispersed through the whole solution and thus the treatment efficiency will increase.

[0045]

[Table 1]

Process		Wash		Shower rinse						Final rinse				Spin dry	
Operation		Supply water	Agitate	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water	Agitate	Drain water	Spin
Time (min)			12		3	1		3	1		5		3		8
COD_{Mn} mg0/*l*	Laundry amount: large			204			30							9	
	: medium			168			25							8	
	: small			120			24							7	

[0048]

[Table 2]

Process		Wash		Ozone treatment	Shower rinse						Final rinse				Spin dry	
Operation		Supply water	Agitate	Agitate Jet	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water	Agitate	Drain water	Spin
Time (min)			12	10		3	1		3	1		5		3		8
COD_{Mn} mg0/*l*	Laundry amount: large			135				30							8	
	: medium			102				20							6	
	: small			59				14							6	

[0053]

[Table 3]

Process	Wash		Ozone treatment	Shower rinse						Final rinse			Ozone treatment	Spin dry	
Operation	Supply water	Agitate	Agitate Jet	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water Shower	Drain water	Spin	Supply water	Agitate Jet	Drain water	Spin
Time (min)		12	10		3	1		3	1		5		10		8

[0050] In this implementation example, a silent discharge type ozone generator using a surface flashover voltage model where a high alternating voltage is applied between the electrodes which are placed on a ceramic substrate is used. As long as a method in which oxygen in the atmosphere is excited by the electric energy is applied, there are no restrictions regarding the method of generating the ozone. Examples of other ozone generation methods include a method in which the ozone is generated on the cathode side by electrolysis in water, a method using ultraviolet rays such that ozone is generated by irradiating oxygen molecules with ultraviolet rays with a wavelength of between 130 and 242 nm or a method in which ozone is generated from oxygen molecules using a high frequency electromagnetic field. In particular, in the case when ozone is generated by using ultraviolet rays, an effect where the organic matter in the solution is decomposed due to the energy of the ultraviolet rays can be produced by directly irradiating the washing solution and the air with ultraviolet rays. In addition, when the contact solution section which is where the ultraviolet rays irradiate the washing solution is composed of materials in which a very finely powdered photoactivated catalyst such as titanium dioxide is fixed by a sol gel glass, the detergent in the washing solution as well as the various types of dirt constituents are oxidised and decomposed and thus the purification effectiveness further increases.

[0051] Regarding the washing conditions shown in Table 2, a powdered compact type of laundry detergent which is available on the market was used. The detergent concentration was 0.07 (wt %) with respect to 57 litres of tap water which is the specified concentration. In addition, underwear which contains the largest amount of organic matter dirt was used as the clothing being washed while the underwear material was a mixture of cotton and synthetic fibre. Three different settings were used for the amount of clothing. The term 'large' in the table refers to a dry weight of 6.0 (kg), 'medium' refers to 5.0 (kg) while 'small' refers to 3.0 (kg). The concentration of the gas which was produced was 15 (ppm) while the air containing the ozone with the gas concentration described above was jetted out at a rate of 55 litres per minute. As a result, for example in the case when a medium amount of clothing was treated, it was found that the COD value of the washing solution before the treatment was 168 (mgO/*l*) whereas the COD value of the washing solution after conducting the ozone treatment for a period of 10 minutes was 102 (mgO/*l*) and thus a reduction of 39 (%) was achieved in a short period of time.

[0052] In addition as shown in Table 3, it is possible to add the ozone treatment operation after the last of the final rinsing processes. The solution which comes in contact with each part inside the washing machine ultimately is the final rinsing water and by adding the ozone treatment operation at the end of the final rinsing process, various types of microorganims which breed on the surfaces of the parts which come into contact with the solution can be eliminated or the breeding of such microorganisms can be restrained.

[0054] Figure 3 shows the second implementation example of this invention. In this second implementation example, ozone is not fed into the washing solution by generating a pressure using an electric motor as shown in the first implementation example described above, however, ozone is dragged into the water current by a water current pump (aspirator) 36, by making use of the water current in the washing solution.

[0055] Figure 4 shows an enlarged view of the water current pump 36, which is used in the second implementation example.

[0056] In addition, the same principle as in the case of the first implementation example 1 described above is applied up until the oxygen in the air which is taken from the intake duct 40, is excited in the ozone generator 37, using electric energy.

[0057] The air containing ozone which is collected in the ozone generator 37, is dragged into the washing solution in the form of foam by making use of the air current which is generated by the water current pump 36. As described above, the fully automatic washing machines which have been available up until now have a mechanism where the washing solution is lifted up near the surface of the water due to the lifting power which is generated by the rotational force of the projecting rib 46, which is placed at the bottom of the agitation impeller 4, in order to filter the solution. The water current pump 36, of this invention is placed at the exit section of the water current.

[0058] As shown in Figure 4, the structure of the water current pump 36, is such that the water current which streams out from the filter 48, flows into the water current entrance 43, and is discharged from the water current exit 44. During the time when the water current is squeezed, since the surrounding gas is pulled in, the air containing the ozone which is collected in the ozone generator 37, is drawn in via the ozone current entrance 45. As a result the air which contains ozone is mixed in the form of a fine foam into the solution which is discharged from the water current exit 44, and this water flows vigorously into the washing water in the washing and spin drying tank 2, and is then dispersed.

[0059] This implementation example has the characteristic that a dynamic mechanism such as a pump to feed the ozone into the washing solution is not required. Consequently, there are some benefits such that only a small space inside the washing machine is required for the installation and the electric power consumption required for the treatment can be reduced.

[0060] In the second implementation example 2, the water current pump 36, is placed in the main unit and this water pump 36, draws the ozone into the washing solution using the water current which is generated. Alternatively for example, it is also suitable if a pump is connected separately on the exit side of the drainage water valve 28, for the purpose of circulation so that the solution is again lifted up to the upper section of the washing and spin drying tank 2 through the lifting force of this pump so that a water current which leads into the surface of the washing solution can be produced and ozone can be mixed into a portion of this circulation path. In this case, a pump which is used exclusively for the solution circulation is required, however, the speed of the water current can be easily controlled and further improved efficient drainage and purification benefits can be obtained.

[0061] Figure 5 shows the third implementation example of this invention.

[0062] In this implementation example an ozone treatment tank 39, is placed in the space inside the washing machine and the ozone is jetted out inside this treatment tank 39.

[0063] The characteristic of this implementation example is that the ozone treatment process is conducted in another tank and not in the washing and spin drying tank 2, unlike the first and second implementation examples described above. The switchover valve 26, is directly connected to the outer tank 5, and the drainage water during the washing process which contains a large amount of detergent and dirt is lead into the ozone treatment tank 39, through the switchover valve 26. The drainage water during the rinse process where the COD value is low is directly emptied into an external drainage water hose 30, by the switchover valve 26, and the water is drained without further treatment. The outlet spout 42, is connected to the ozone treatment tank 39, in a similar way to the case of the first implementation example and the air containing ozone is jetted out from this outlet into the water. The gas supply valve 41, is closed during those periods when ozone is not supplied. When ozone is jetted out into the washing water, the ozone generator 37, is activated and, at the same time, the air pump 35, is also activated. The gas supply valve 41, is opened while both the ozone generator and the air pump are activated. The excess portion of the drainage water which flows into the ozone treatment tank 39, overflows and is drained from the drainage water hose 31, which is installed in the top section of the tank. In the structure of this implementation example, the capacity of the ozone treatment tank is 35 litres which is approximately half the capacity of the washing and spin drying tank 2, and this is because of the space constraints inside the washing machine. As a result, approximately half of the drainage water with a high COD value can be treated and the remaining half discharged without the ozone treatment. However in this structure, since sufficient time can be spent on performing the ozone treatment, there is an advantage that a high level of treatment can be attained. Since at most 24 hours can be used for the ozone treatment, although only half of the amount of water is treated in comparison with the case of the first implementation example, this makes it possible to easily double the effectiveness of the COD value reduction and, as a result, the same benefits as if the total COD value was decreased can be attained. Even in the case when the washing machine is used continuously for more than two cycles, the time up until when the water from the washing process is drained in the second washing operation can be used for the ozone treatment. For example, in the case of the process which is shown in Table 2, 36 minutes can be added to the drainage water time at each process and thus at least approximately 40 minutes can be spent on the ozone treatment. As a result, a treatment which is approximately 4 times more than the case in the first implementation example is possible. In the case when the capacity for the ozone treatment tank 39, cannot be secured, it is possible to increase the treatment efficiency by increasing the concentration of the ozone which is supplied. Primarily the aim is to reduce the COD value in the solution by using the oxidation decomposition reaction of ozone, however, at the same time laundry dyes may sometimes also decompose. When ozone at high concentrations is reacted, discolouration / fading of the washed clothing may occur and thus the concentration of the ozone is constrained in the case when the ozone treatment is conducted in the washing and spin drying tank 2. However, in the case of the third implementation example, since only the drainage water is subjected to the ozone treatment, this makes it possible to attain a high level of treatment with a sufficient concentration and for a long enough time.

[0064] In this implementation example since the ozone treatment tank 39, is placed inside the washing machine, there is a restriction on the capacity of the tank, however, the tank can be placed externally outside the washing machine. In this case, a sufficient capacity for the tank can be obtained.

[0065] In addition in all of the implementation examples described above a washing machine in which the main unit of the washing machine uses an agitation impeller and where the washing tank is rotated in a vertical direction is described, however, this invention is not limited to this type alone. In order words, the same benefits can be obtained for a drum type machine where the washing tank is rotated in a horizontal direction. In the case of a drum type machine, the washing tank is sealed and since if the ozone which is generated fills the space inside the washing machine then the air containing ozone in the space and the washing solution will mix as the rotational motion starts and a process for mixing the ozone gas into the washing solution which is compulsory is not required which is an advantage.

[0066] Further, this invention can also be applied to the so-called twin-tub washing machine in which a washing tank and a spin drying tank are built side by side.

[0067] Figures 6 and 7 show the case when this invention is applied to a dish washer.

[0068] In other words Figure 6 is a diagram which explains the internal structure of a dish washer while Figure 7 is a diagram explaining the internal structure for a different cross sectional area of a dish washer from Figure 6.

[0069] The item 49, in Figures 6 and 7 refers to the general dish washer which has a box shaped outer frame 50. The dish storage tank 51, is placed inside the outer frame 50, and a door 52, is fitted to the front opening section. The rack section 51a, is placed on the lower side wall section of the dish storage tank 51, and a lower basket used to place dishes 53, which can be attached / removed freely is placed on the rack section 51a.

[0070] The rail 54, which is mobile and can move forwards and backwards is installed on the upper side wall section of the dish storage tank 51, and an upper basket used to place dishes 55 fits onto the rails 54, so that the upper basket used to place dishes 55, can move freely in and out.

[0071] A water supply pump 56, is placed below the dish storage tank 51, as shown in Figure 6 and the water supply pump 56, has a pump motor 57. A lower arm nozzle 58, which rotates with the central section as a fulcrum is placed directly below the lower basket 53, which is used to hold dishes and a multiple number of small holes 58a, are provided in the top surface of the lower arm nozzle 58. A venturi tube 59b, which sends the washing water which is supplied by the water supply pump 56, to the upper arm nozzle 59, is placed in the lower basket 53, used to hold dishes. The upper arm nozzle 59, which also rotates with the central section as a fulcrum is placed directly below the upper basket 55, used to hold dishes and a multiple number of small holes 59a, are provided on the top surface of the upper arm nozzle 59.

[0072] A heater cover 61, is located at the back of the dish storage tank 51, which covers the heater 60, as shown in Figure 7. A water supply electromagnetic valve 62, is installed in addition to the heater 60, described above at the back of the dish storage tank 51.

[0073] An exhaust gas duct 63, is placed over the dish storage tank 51, and the exhaust gas duct 63, is connected to the exhaust gas outlet 64. A control panel 65, is placed above the door 52.

[0074] Further, a water supply pump 66, is located in addition to the water supply pump 56, which is described above below the dish storage tank 51 as shown in Figure 6.

[0075] Next the operations of washing, rinsing with water, rinsing with warm water and drying of the dish washer having the structure described above will be explained.

[0076] Firstly, the washing operation includes the following. Electricity is turned on at the water supply electromagnetic valve 62, washing water is supplied to the dish storage tank 51, electricity is turned on to the pump motor 57, while electricity is kept on at the heater 60, a runner for washing 68, is rotated, water is drawn in from the water reservoir 69, which is located at the bottom of the dish storage tank 51, pressure is supplied from the pump spout exit 70, into the inside of the lower arm nozzle 58 and into the venturi tube 59b, and pressure is supplied from the venturi tube 59b to the inside of the upper arm nozzle 59. Then pressurised water is directly jetted out from the small holes 58a, in the lower arm nozzle 58, onto the dishes which are placed in the lower basket 53. In addition, pressurised water is directly jetted out from the small holes 59a, in the upper arm nozzle 59, onto the dishes which are placed in the upper basket 55. Dirt which is adhered to the dishes can be separated and dispersed by the jetting operation described above. Furthermore, pressurised water from both the lower and upper arm nozzles 58 and 59, respectively, is jetted out over the entire area inside the dish storage tank 51. When the washing operation is conducted for a specified period of time, electricity to the pump motor 57, and the heater 60, is turned off to finish the washing operation, and electricity is turned on to the drainage water pump 66, to discharge the washing water in the dish storage tank 51, outside of the machine.

hot water heating

[0077] Next, the rinsing operation is conducted by repeating the same operations as the washing operation described above several times. During this operation, electricity is turned on to the heater only during the warm water rinsing operation and it is not turned on during the other rinsing operations.

[0078] Finally the drying operation includes the following. Electricity is turned on to the air blower unit 67, to rotate the air blowing fan 71, and air is blown inside the dish storage tank 51, the air blow duct 72, the heater 60, and the air blow path 73 which are located below the dish storage tank 51. Furthermore, during this operation the heater 60, warms the cold air by turning the electricity supply on and off for a certain period of time and this warm air changes the water droplets which have adhered to the inside of the dish storage tank 51, the remaining water in the tank and the water droplets which have adhered to the dishes which are placed inside the upper and lower baskets, 53 and 55, respectively, into vapour which is discharged outside of the machine via the exhaust gas duct 63, and the exhaust gas outlet 64.

[0079] When the drying operation has been conducted for a certain period of time, the operation of the dish washer 49, is stopped.

[0080] In this implementation example, an outlet spout 74, is attached in the vicinity of the lower section of the dish storage tank 51, and the air containing ozone is jetted out into the water from the outlet 74.

[0081] The gas supply valve 75, is closed during the times when ozone is not supplied.

[0082] When ozone is jetted out into the washing water, the ozone generator 76, is activated and, at the same time, the air pump 77, is activated. While both the generator and the pump are activated, the gas supply valve 75, is opened. Through the series of actions described above, a portion of the oxygen in the air which is drawn in from the intake 78, is excited inside the ozone generator 76, using electric energy which is then converted into ozone. This air which contains the ozone is jetted out in the form of a foam into the washing water which is stored in the dish storage tank 51, as a result of the pressure which is generated by the air pump 77. The ozone in the foam dissolves into the water and through the oxidative power the organic matter in the water is oxidised and decomposed and is converted into low molecular compounds which results in a decrease in the COD and BOD values in the washing water.

Ozone dissolves in water and absorbed ozone [illegible]

[0083] In this invention in the case when the ozone which is generated cannot completely dissolve in water, it is released as an unreacted gas into the atmosphere. Ozone has the characteristic that it decomposes by itself even at room temperatures and even when it is left untreated it returns back to oxygen naturally, however, the ozone which is mixed in the gas has a bad smell and thus when a machine is used for household purposes it is preferable to discharge it outside of the machine after the decomposition treatment. Methods which can be used for the treatment of the discharge of ozone include a technique in which ozone is changed to oxygen or carbon dioxide by letting the ozone come into contact with activated carbon, a method in which the ozone is thermally decomposed by leaving the ozone in an atmosphere of approximately 300°C for a period of a few seconds, or a technique in which ozone is decomposed at a low temperature of around 40°C using a catalytic substance such as nickel oxide or manganese dioxide.

Does this happen in the [illegible]

NB

Can we say that such unreacted O_3 is released directly into atmosphere. Does it happen so.

[0084]

[Benefits of the invention] According to this invention, since the oxidative power of ozone decomposes the constituents of various types of detergents such as surfactants and aid agents in the washing solution, bleaching ingredients, enzymes, fluorescent ingredients, metal neutralisers and perfumes as well as contaminants such as fatty ingredients, the BOD and COD values in the drainage water can be reduced. In regions where sewerage treatment facilities are provided, the workload on the centralised treatment facility can be reduced and, in addition, in regions where sewerage treatment facilities are not provided, there is the benefit of reducing the pollution in rivers, lakes, swamps and the ocean.

[0085] Since oxygen in the air or in the water is used as a raw material for the ozone which is generated using electric energy, this has the advantage that maintenance operations such as the supplement of chemicals or the replacement of components is unnecessary.

[0086] Since the treatment process using the ozone is conducted in the solution collection section which is established separately from the washing tank, sufficient time can be spent on the decomposition of the organic matter and, furthermore, a high level of benefit in the reduction of BOD and COD values in the drainage water can be attained. In this case not necessarily all of the washing solution is treated but a portion of the solution is collected which is then treated to a high degree so that the same benefit as if the total solution were treated at a lower level can be attained. Consequently a reduction in the COD and BOD values can be obtained even when there are space constraints.

[0087] In addition, since a water current pump using the water current which is generated from the agitation force of the washing appliance is applied in order to mix the air containing ozone into the solution concerned, a compulsory mechanism to distribute the air using an electric power driven compressor or various types of pumps is not required which contributes to a saving in the electric power consumption and to a simplification in the structure of the machine.

[0088] Ozone has strong disinfectant properties and it is known that it is beneficial in destroying or in restraining the growth of various types of moulds and bacteria. For example, colon bacteria or yellow staphylococcus which floats in water can be destroyed 100% of the time on contact with ozone having a concentration of 0.5 (ppm) for a period of 15 seconds. This property makes it possible to restrain the breeding of microorganisms inside washing appliances.

[0089] Dirt adheres to those areas where the washing solution easily stagnates such as on the internal walls of washing appliances and microorganisms such as moulds and bacteria can easily start to breed using the dirt described above as their nutritional source. The breeding of these microorganisms has several negative effects in that it can become a source of bad odours or can contaminate the laundry. In order to restrain the breeding of moulds and bacteria, some countermeasures such that antibacterial agents, antimoulding agents or materials which restrain the breeding of microorganisms can be mixed with the raw material components themselves, or that antibacterial or antimoulding coatings can be applied to the surfaces of the components concerned where moulds and bacteria are known to develop. However, these countermeasures have limitations in terms of the sustainability of their effectiveness and the benefits deteriorate as the effective ingredients wash away / liquate out. In addition, the effective ingredients which are exuded from the surface of these components should penetrate through the stagnant dirt onto the surface and thus high concentrations of such agents are required. In the case of the application of ozone, since it is contained in the washing solution and comes into direct contact with those microorganisms which breed on the surface of the stagnant dirt, the multiplication of the microorganisms can be effectively restrained. In addition, some of the antibacterial agents and antimoulding agents which are highly effective are very toxic to humans and thus there has been some anxiety towards the use of such agents. However, ozone has the characteristic that it decomposes by itself at room temperatures and there is no anxiety over the toxicity as it returns back to oxygen naturally even when left untreated.

[0090] According to this invention, since ozone is mixed into the washing solution after a sufficient washing time with the aid of a detergent and after agitation has been done, the constituents within the detergent are not oxidised and decomposed and thus the washing effectiveness cannot deteriorate.

[0091] In addition, ozone can be used after completing the washing process during which a detergent is used, however, in the case when the benefit of sterilisation of the washing appliance is required, ozone can also be jetted out during the final rinsing process during which the washing solution comes into contact with the washing appliance for the last time.

[Brief description of the figures]

[Figure 1] This figure shows the basic structure of a fully automatic washing machine.

[Figure 2] This figure shows the first implementation example in the case when this invention is applied to a fully automatic washing machine.

[Figure 3] This figure shows the second implementation example in the case when this invention is applied to a fully automatic washing machine.

[Figure 4] This is an enlarged figure of the water current pump which is indicated as item 36 in Figure 3.

[Figure 5] This figure shows the third implementation example in the case when this invention is applied to a fully automatic washing machine.

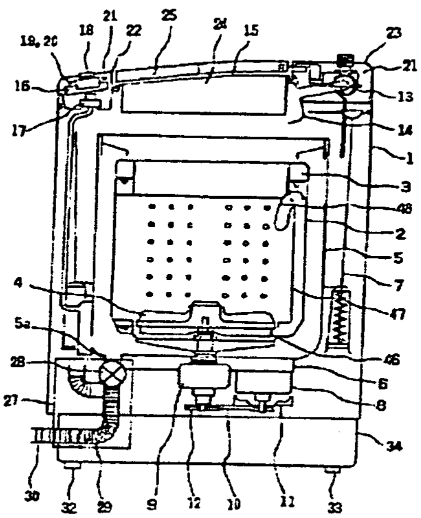
[Figure 6] This figure shows one of the implementation examples in the case when this invention is applied to a dish washer.

[Figure 7] This figure explains the internal structure of the dish washer which shows a different cross sectional area from that shown in Figure 6.

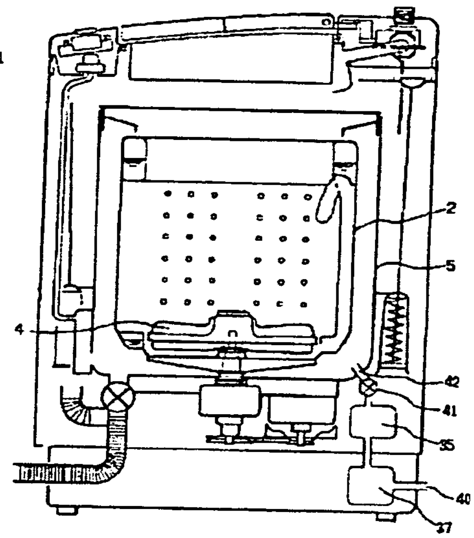
[Key to the symbols]

1... outer frame, 2... washing and spin drying tank, 4... agitation impeller, 5... outer tank, 28... drainage water valve, 35... air pump, 36... water current pump, 37... ozone generator, 38... ozone chamber, 39... ozone treatment tank, 40... intake, 41... gas supply valve, 42... outlet spout, 43... water current entrance, 44... water current exit, 45... ozone current entrance, 50... outer frame, 51... dish storage tank, 55... upper basket to place dishes, 53... lower basket to place dishes, 58... lower arm nozzle, 59... upper arm nozzle, 74... outlet spout, 75... gas supply valve, 76... ozone generator, 77... air pump, 78... intake.

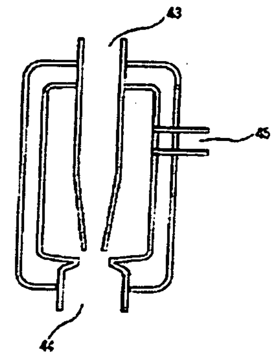
[Figure 1]



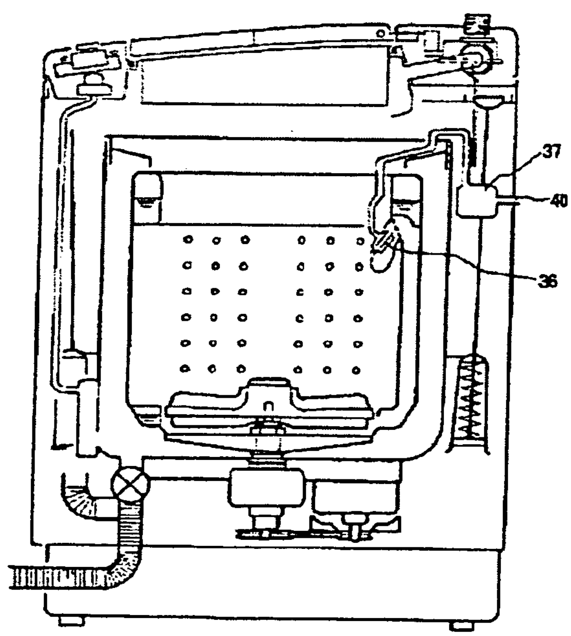
[Figure 2]



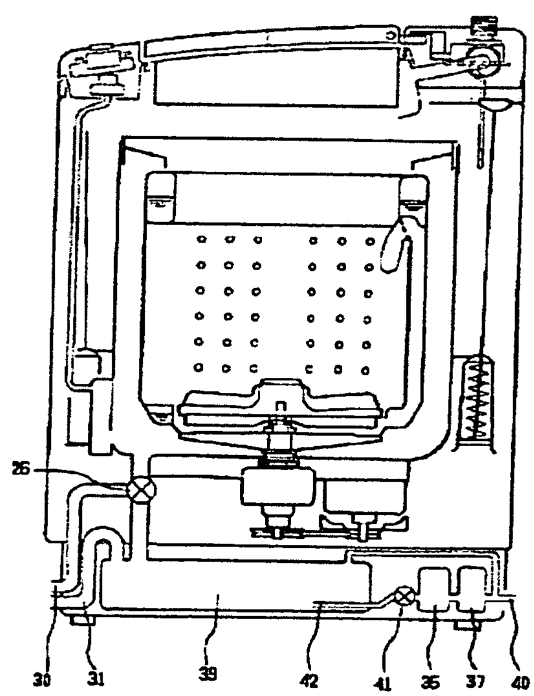
[Figure 4]



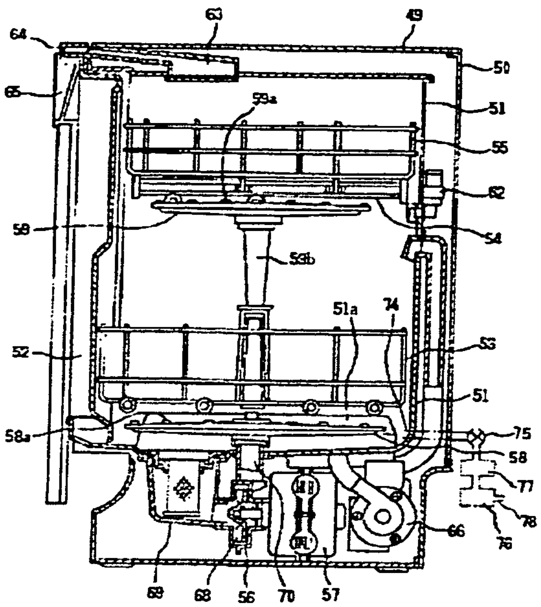
[Figure 3]



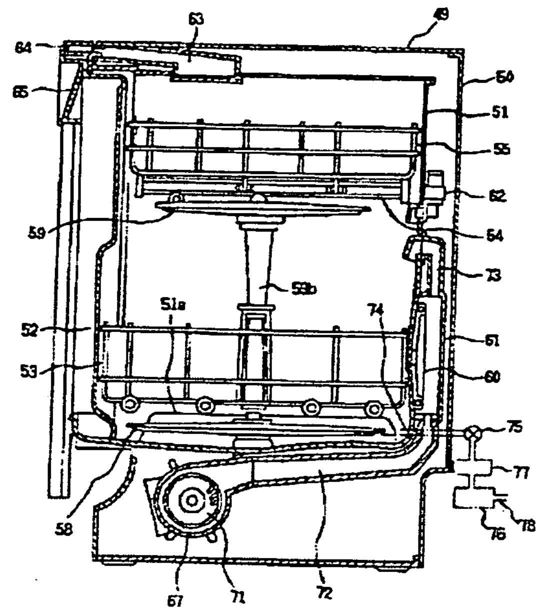
[Figure 5]



[Figure 6]



[Figure 7]



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(72) Inventor Tetsuo Ishikawa
Taga Head Office, Electric Appliances Project Division, Hitachi Works Co. Ltd., Higashi Taga-cho 1-chome 1-ban 1-go, Hitachi-shi, Ibaraki-ken

(72) Inventor Takami Koyama
Taga Head Office, Electric Appliances Project Division, Hitachi Works Co. Ltd., Higashi Taga-cho 1-chome 1-ban 1-go, Hitachi-shi, Ibaraki-ken

(72) Inventor Noriko Shimasaki
Taga Head Office, Electric Appliances Project Division, Hitachi Works Co. Ltd., Higashi Taga-cho 1-chome 1-ban 1-go, Hitachi-shi, Ibaraki-ken